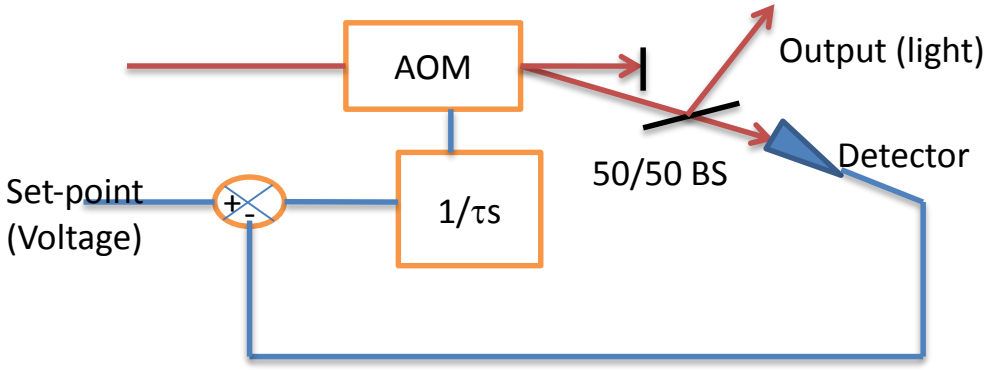
Electro-optics course, exercise # 3

1. Laser intensity noise-eating

   To suppress intensity noise in a laser beam it passes through the following noise-eating circuit:



   Acousto Optic Modulators are optical switches that diffract light into a given direction from a traveling acoustic wave that can be switched on or off.

   The beam waist in the AOM is 1 mm and the distance of the acoustic transducer from the beam waist is 3 mm. The velocity of sound in the AOM is 4000 m/sec. The integrator transfer function is $1/\tau*s$. Assume that the photo-detector is ideal with 1 V/Watt responsivity. The diffraction efficiency of the AOM is equal to the voltage applied to the AOM controller in Volts.

   a. Calculate the time response of the optical output for a step function control voltage input at t=0, neglecting the acoustic delay in the AOM.
   b. With the delay included, plot the open-loop and closed-loop Bode plots (Gain and phase) of this control system. What is the optimal τ for low frequency noise cancelation at which the noise eater is stable? By what factor is light intensity noise at 100 Hz reduced at this τ?